REMARKS

Applicant has amended claims 1, 3, 4 and 14. Claims 1-16 are still pending in this application.

Applicant has amended paragraph 24 of the specification to correct a minor typographical error.

In the Office Action, the Examiner indicated that claims 8-11 are allowable. Applicant gratefully acknowledges the indication of allowable subject matter. Applicant has rewritten allowable claims 8 and 10 into independent form.

The Examiner objected to several portions of the drawings as failing to show every feature of the claimed invention. First, the Examiner asserted that the drawings do not show a "void portion opposed to said head unit". Applicant submits that at least FIG. 1 shows a void portion 32 of a heatsink 31 which is opposed to the head unit 40 including an actuator 43 and cavity unit 42.

Second, the Examiner asserted that the drawings do not show "two opposed or void portions which are opposed to the respective two head units". Applicant can find no such phrase in any claim. However, Applicant assumes that the claim in question is claim 14 which closely resembles the quoted language. Applicant submits that at least FIG. 1 shows four void portions 32 of a heatsink 31 which are opposed to the respective head units 40 including an actuator 43 and cavity unit 42. The two left void portions oppose the left head unit 40 and the two right void portions oppose the right head unit 40. FIG. 2 shows one left void portion 32 opposing the left head unit 40 and one right void portion 32 opposing the right head unit 40.

Third, the Examiner asserted that reference characters 44 and 45 point to the same object in FIG. 2. Applicant thanks the Examiner for pointing out the error. Applicant has amended FIG. 2 so that element 45 points to the driver element. No new matter is added as the change is fully supported in the specification.

The Examiner objected to claims 3 and 4 for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Examiner feels that a void can not have an aperture as claimed in claims 3 and 4. Applicant respectfully submits that claims 3 and 4 are more explicitly defining what is meant by "void portion". As the Examiner pointed out, a void has a broad meaning that can be considered to be an opening, gap, or empty space. With claims 3 and 4, Applicant is further defining the void to

include an aperture that goes through the heatsink. For example, the void can be a recess on a bottom surface of a heatsink and an aperture such as a through-hole can be located in the recess. Applicant submits that since claims 3 and 4 further limit the "void portion" as recited in claim 1, they are definite and clear. Although not necessary, to advance the prosecution of the application, Applicant has amended claims 3 and 4 to make it clear that the "aperture" is an opening that goes through the heatsink by reciting "an aperture formed through said heatsink between said first surface and said second surface". For these reasons, withdrawal of the claim objection is respectfully requested.

The Examiner rejected claims 1 and 3 under 35 U.S.C. Section 102(e) as being anticipated by Drury (US 2003/0150931). Applicant respectfully traverses the rejection.

The present invention concerns a recording apparatus which will be explained, by way of example only, with reference to FIGS. 1-3 and related description in the present specification.

Generally, as shown in FIG. 1 of the present specification, a recording apparatus has (a) a head unit 40 including an actuator 43 which generates energy required for recording predetermined patterns of image on a recording medium, (b) a circuit board including a driver element 45 (such as an integrated circuit chip) which drives the actuator 43, and (c) a heatsink 31 disposed in thermally conductive communication with the driver element 45.

In recent years, as a result of an ever increasing number of nozzles with an increased density in the head unit, a wiring arrangement connecting the driver element and the actuator has become denser which caused the wires to be increasingly susceptible to noise. As a result, it has become necessary to position the driver element 45 closer to the actuator 43 to reduce the length of each wire in the wiring arrangement.

The increased nozzle density also led to an increase in the amount of heat generated by the driver element 45, which is easily transferred through the heatsink 31 and to the actuator 43 which is positioned to be close to the driver element 45. The heat applied to the actuator causes a change in the actuation property (particularly, where piezoelectric elements are used in the actuator). Also, the heat applied to the ink causes physical properties of the ink to be changed. The changes in the actuation property of the actuator and the physical property of the ink cause deterioration in the quality of the printed image.

According to the invention of claim 1, the above problem is solved by providing a void portion 32 (see FIG. 2 which is a bottom view of the recording head) in at least one surface of

the heatsink with the void portion facing the actuator so as to minimize any heat transfer to the actuator from the heatsink. Therefore, even if the heatsink 31 becomes very hot, significant changes in actuation property of the piezoelectric actuator 43 and physical property of the ink are prevented. This results in a reliable high quality printing operation without any deterioration in the quality of the printed image.

To make this novel feature clearer, Applicant has amended claim 1 to (1) "a heatsink having a first surface and a second surface opposite to the first surface, and having at least one of said first and second surfaces disposed in thermally conductive communication with said driver element" and (2) "wherein said heatsink has a void portion on at least one of said first and second surfaces and which is opposed to said head unit". In other words, the surface of the heat sink's void portion facing the actuator is on the same or opposite surface as the heat sink surface in thermal communication with the driver element. For example, in the embodiment shown in FIG. 1, a lower surface of the heatsink 31 faces the actuator 43 and the lower surface is also in thermal communication with the driver element 45.

The Examiner asserted that Drury discloses all of the features recited in claim 1. In particular, the Examiner pointed to heatsink 160 in FIG. 7 of Drury as teaching the heatsink as claimed. Applicant respectfully disagrees. As can be clearly seen in FIG. 6 of Drury, the heatsink 160 does not extend over the head unit 100 because the side surface and ink outlet 154 of the ink manifold 150 stops the heatsink from extending over the head unit. That means the heatsink 160 cannot possibly have a "void portion which is opposed to said head unit" as recited in claim 1.

Moreover, even if the heatsink of Drury were to have a void portion that is opposed to the head unit, the surface that faces the head unit 100 is a vertical side surface while the surface in thermal communication with the driver element 130 is either a horizontal upper surface or horizontal lower surface (opposite to the upper surface) as clearly seen in FIG. 7. Since claim 1 calls for the surface of a void portion opposing the head unit to be either on the same surface or opposite surface that is in thermal communication with the driver element, Drury fails to disclose such a feature because the vertical side surface of the heatsink 160 facing the head unit 100 is not on the same or opposite surface that is in thermal communication with the driver element 130.

Dependent claim 3 is also patentable by virtue of its dependency from claim 1.

The Examiner rejected claims 2 and 4-7 and 12-15 under 35 U.S.C. Section 103(a) as being obvious over Drury in view of one or more of the following references: Isono (US Patent No. 6604817), Hilton (US Patent No. 6655785), Teung (US Patent No. 6945638), Sugiyama (US Patent No. 6339444). Applicant respectfully traverses the rejection.

For the similar reasons as discussed above with respect to claim 1, Applicant submits that independent claim 14 is also patentable. Dependent claims 2, 4-7, 12-13 and 15 are patentable by virtue of their dependency from independent claims 1 and 14.

The Examiner rejected claim 16 under 35 U.S.C. Section 103(a) as being obvious over Drury in view of Baxter (US 2004/0021721). Applicant respectfully traverses the rejection.

The Examiner admits that Drury fails to teach a heatsink which includes a horizontally extending plate portion and a vertically extending plate portion and which is disposed in thermally conductive communication with the driver element. The Examiner then relies on Baxter to compensate for the deficiency of Drury, asserting that the heatsink 9 of Baxter is disposed in thermally conductive communication with an element 3. Applicant respectfully disagrees. As described in paragraph 25 of Baxter, the heatsink 9 is positioned to be in thermal communication with the nozzle array 3. The nozzle array 3 is not a driver element as recited in claim 16. It is not described in Baxter that the nozzle array 3 includes a drive element or its equivalent operable to drive an actuator of the print head 1. Accordingly, Baxter either individually or in combination with Drury does not teach or suggest the novel combination of features as claimed in claim 16.

Applicant has added new claims 17-20. No new matter is added as the claims are fully supported by the specification.

For claim 18, it recites that "said heatsink includes a plate portion" and "said heatsink has an aperture which is opposed to said head unit and which is formed through a thickness of said plate portion". In Drury, the ink passage of the heatsink 160, having the opening aligned with the ink outlet 154 of the second manifold 152, is not formed through a thickness of the plate-like heatsink 160. Rather, although not being described specifically, it is considered that the ink passage of the heatsink 160 extends in a direction perpendicular to a thickness direction of the heatsink 160, for conveying an ink away from the second manifold 152 toward an ink reservoir.

In Hilton, a plurality of through-holes are formed through a thickness of the plate-like heatsink 304. However, each of the through-holes of the heatsink 304 is located on an upper

side of the inkjet assembly 312 (as seen in FIG. 10 of Hilton), and accordingly is not aligned with or opposed to the inkjet assembly 312. Further, even if one of the through-holes of the heatsink 304 were opposed to the inkjet assembly 312, the through-hole could not serve to minimize transfer of heat from the heatsink 304 to the inkjet assembly 312, because each through-hole of the heatsink 304 is provided for receiving therein a screw and is closed by the screw when the heatsink 304 is assembled with other components.

Based upon the above amendments and remarks, Applicant respectfully requests reconsideration of this application and its earlier allowance. Should the Examiner feel that a telephone conference with Applicant's attorney would expedite the prosecution of this application, the Examiner is urged to contact him at the number indicated below.

Respectfully submitted,

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